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Stereotyping in Developmentally Delayed Children: Contingent and Non-Contingent Movement

K.B. Hranchuk, N.D. Durie, and R. Farley

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ABSTRACT

An extensive review is presented of literature concerning maladaptive behaviour in developmentally delayed children. Both self-stimulatory and self-injurious behaviours are discussed. The present study is of the effects of movement on each behaviour. The movement was provided by a specially-developed vehicle. The paper concludes with a protocol for the use of this vehicle in the training of developmentally delayed children.

RÉSUMÉ

On présente un examen approfondi de la documentation qui existe sur le comportement mésadapté d'enfants atteints d'un retard développemental. On traite à la fois des comportements auto-stimulants et auto-mutilants. La présente étude porte sur les effets de la mobilité sur chaque type de comportement. La mobilité était assurée par un véhicule spécialement conçu à cette fin. En conclusion, on présente un protocole pour l'utilisation de ce véhicule aux fins de l'apprentissage d'enfants atteints d'un retard de développement.

STEREOTYPY IN DEVELOPMENTALLY DELAYED CHILDREN: CONTINGENT AND NON-CONTINGENT MOVEMENT

K.B. Hranchuk, N.D. Durie, and R. Farley

A critical problem in developing educational programs for the developmentally delayed is a high rate of maladaptive behaviour in that population. Professionals involved in teaching the developmentally delayed are fully aware of the difficulty in dealing with such behaviours as stereotypical motor acts manifest as self-stimulation or self-abuse. The procedure described in this report is an attempt to reduce such behaviours in two blind severely developmentally delayed children utilizing movement generated by an electronic bumper car. Before describing the rationale and procedure for the experiment, a literature review of self-stimulation, followed by a similar review of self-abuse, will be presented.

Baumeister (1) describes stereotypical behaviour (self-stimulation) as behaviour occurring at high rates, in a repetitious manner, without appearing to have any adaptive function. The behaviours do not typically result in physical harm to the person demonstrating the behaviour or to others in the environment. However, due to the bizarre nature of such behavioural patterns and their high frequency of occurrence, methods to teach more adaptive behaviours are often ineffectual. Examples of such behaviours include body rocking (2), hand gesturing (3), mouthing objects (4), stereotypical verbalization (5), and head nodding (6). These behavioural patterns are quite common in the severely and profoundly retarded and have been estimated to occur in up to two-thirds of that population (7).

Theoretical speculation concerning the etiology of stereotypical acts is wide and varied. Berkson and Devenport (8) have put forth the theory that such behaviour is an attempt to achieve optimal levels of stimulation to compensate for low levels of environmental activation. Alternatively, Hutt and Gibby (9) have suggested that stereotypical acts serve as a filtering mechanism which reduces stimulation in persons who are unable to respond to excessive environmental stimulation. Similarly, Baumeister and Forehand (10) suggest that stereotypy reduces frustration, tension, and anxiety. These theoretical propositions, while important to the understanding of stereotype, remain speculative and lack systematic research for their support. Of more importance to the present research are the treatment procedures that have been applied to such stereotypical self-stimulating behaviours.

Applied behaviour analysts have performed and developed the majority of research as well as clinical applications for the reduction of

stereotypy. Schrader et al. (11) have presented an excellent review of the behavioural treatment of self-stimulation in the developmentally delayed. Using a methodology similar to an earlier review (12), Schrader et al. assessed 38 studies using 17 methodological variables to analyze treatment effectiveness. Much of the present review of treatment procedures for self-stimulation is based upon the article by Schrader et al. (11).

Positive reinforcement of any behaviours other than stereotypy (differential reinforcement of other behaviour (DRO)) and differential reinforcement of behaviours incompatible with stereotypy (DRI) have been utilized by researchers treating self-stimulatory stereotypical patterns.

Repp et al. (13) demonstrated that by using a DRO interval based on their subjects' baseline rates of behaviour they were able to reduce stereotypical acts in terms of frequency and variability. Their subjects were six retarded children who demonstrated self-stimulatory and self-abusive behaviours. These results were in contrast to an earlier study by Mulhern and Baumeister (14) who failed to significantly reduce stereotypy in two retarded males using a DRO procedure. Favell (15) and Rojahn et al. (16) using DRI techniques found results similar to Repp et al. (13) in their attempts to reduce stereotypical acts in retarded persons. Both researchers demonstrated that reinforcing appropriate toy play resulted in reduced stereotypy and increases in appropriate play and frequency of contact with toys. These results using DRO and DRI treatment strategies are very encouraging but are difficult to apply clinically. In order to be effective in the reduction of stereotypical acts the procedures must be applied consistently and for long periods of time. Therefore limited staff time, which is always a critical factor in developing such programs, decreases the usefulness of such procedures.

Related, but not identical to DRO procedures, are techniques that result in the removal of reinforcement for stereotypical behaviours. For example, Rincover and his associates (3, 17) have demonstrated that sensory extinction techniques can control and reduce stereotypical behaviours. Sensory extinction involves removing or reducing the amount of sensory feedback a person receives from performing stereotypical behaviours. Rincover et al. (17) demonstrated that by removing the auditory feedback received from spinning objects on a table by carpeting the surface of the table reduced such self-stimulation to zero levels. Research in this area is still quite sparse, but holds much promise since the therapy requires little staff training and appears to be effective.

The application of punishing aversive stimuli contingent upon stereotypical acts has also been used as a therapy by behaviourists to reduce

such behaviour. The contingent administration of shock to reduce stereotypy was one of the earlier punishment procedures to be developed (18-21). The effects of contingent shock on self-stimulation as demonstrated by the above researchers is an almost immediate suppression of the behaviour. There are, however, numerous problems in using shock as a punishment. Besides ethical considerations associated with contingent shock, the therapy also appears to be situation specific (22) in that suppression does not generalize from treated to non-treated environments. This problem can be rectified by applying shocks in novel environments (19), but does limit its applicability and efficiency. Other forms of punishment that have resulted in varying degrees of suppression of self-stimulation are slaps (23, 24), loud verbal reprimands (21), and time-out from positive reinforcement (25). These latter punishment techniques also present ethical concerns and problems in application similar to that of contingent shock, although to a lesser degree.

The most common intervention that has been employed to reduce self-stimulation is overcorrection (26). Overcorrection is a multielement treatment procedure that involves returning an environment disrupted by a maladaptive behaviour to its original state (restitutional overcorrection) as well as repeatedly practising correct or more positive behaviour topographically related to the disruptive behaviour (positive practise overcorrection). According to Schrader et al. (11) overcorrection was the treatment of choice in approximately 40% of the research studies they reviewed. Schrader et al. (11) also reported that overcorrection is generally effective in reducing stereotypy, requires little program time and is easily applied throughout the day. The following is a summary of some of the research using overcorrection with self-stimulation.

Foxx and Azrin (4) compared overcorrection for excessive mouthing with four other procedures: slapping, a distasteful solution, DRO, and non-contingent reinforcement. The results were superior for overcorrection when compared to the other procedures in that consequent to positive practise, mouthing was reduced to a zero level. Azrin et al. (26) compared DRO alone and in combination with overcorrection with nine severely and profoundly retarded subjects demonstrating a variety of stereotypical behaviours. The results after two days of treatment indicated a 66% decrease in stereotypy for DRO alone and a 95% decrease for overcorrection plus DRO. These results are quite impressive and are further supported by O'Brien (27) who cites 13 studies that support over-correction as an effective method for treating stereotypical self-stimulation.

There are, however, significant research programs that present data not in support of overcorrection as a method to reduce self-stimulation.

For example, Cohen et al. (28) in a study comparing DRO with positive practise overcorrection found that DRO reduced finger twirling 20-30% more than overcorrection. In addition, Rollings et al. (6) found overcorrection to be ineffective with stereotypical head nodding in one of two subjects. That subject began to demonstrate head banging once the overcorrection procedure was introduced. In their second subject overcorrection reduced body rocking, but failed to generalize from a treatment area to the subject's ward environment. This later finding of poor generalization across settings appears to be one limiting factor of overcorrection as a treatment and has been documented by others (29-31). In spite of the problems with overcorrection it appears to be the behavioural treatment of choice at present.

The research cited above reveals that behaviourists have progressed in the treatment of self-stimulatory behaviour with varying degrees of success. Similar treatment strategies have been developed for self-injurious stereotypical behaviour.

Although similar to self-stimulation, self-abusive or self-injurious behaviour is a much more serious form of stereotypy. Self-injurious behaviour usually presents a serious danger to the person involved in that tissue damage usually occurs, and in some extreme cases death of the person may be a real possibility. Of critical importance in self-injurious behaviour is the frequency and intensity of the behaviour. In some cases the self-injurious behaviour may occur upwards to hundreds of times an hour for lengthy periods of time. It is, therefore, very important to develop treatment strategies to reduce such behaviour as quickly and efficiently as possible. As with self-stimulation, applied behaviour analysts have performed the majority of research and have developed most therapeutic interventions for self-injurious behaviour. The procedures used to reduce and/or eliminate self-injury are similar to those developed for self-stimulation and are reviewed briefly below.

Self-injurious behaviours are typically demonstrated by retarded and autistic persons. Baumeister and Rollings (32) have estimated that the occurrence of self-injurious behaviour is between 8-14% of retarded populations. Ross (33) reports that the lower a person's IQ the more severe and frequent self-injury becomes in the retarded population. In an extensive analysis of 208 subjects in a state institution, Schroeder et al. (34) found that head banging, biting, and scratching were the most prevalent forms of self-abuse. In addition, those same researchers found that over 50% of their samples manifested multiple forms of self-injurious behaviour. Other forms of self-injurious behaviour include eye poking, hair pulling, vomiting, and eating objects such as cigarettes and feces (35).

From an etiological point of view, as with self-stimulation, Baumeister and Rollings (32) have discussed self-injury in terms of a need for stimulation. There has only been anecodotal support for this theory and further research is required for its support. Baumeister and Rollings have also suggested that self-injurious behaviour in the retarded results from a disruption in normal development. This theory has received some support in that DeLissovoy (36) reported that 15.2% of a sample of normal children (19-23 months old) demonstrated head banging. Others (37, 38) have suggested that self-injurious behaviour is learned. However, as with self-stimulatory behaviour, the etiology of self-injurious behaviour remains basically unknown. Of more relevance to the present research are the treatment strategies employed to reduce such severe stereotypical behaviour.

In an extensive analysis of self-injurious behaviour an Association for the Advancement of Behaviour Therapy Task Force headed by Favell reviewed numerous aspects of the disorder and made a number of treatment recommendations (35). The report states that the application of brief durations of punishing electric shock contingent upon self-injurious behaviour is the most effective and widely researched treatment procedure. Although fraught with the same ethical and methodological difficulties for reducing self-stimulation, contingent shock and its effect on self-injurious behaviour will now be briefly reviewed. That will be followed by a review of alternative treatment strategies for self-injurious behaviour.

Butterfield (39) describes the use of electrical shock as a physically harmless but intensely noxious stimulus, which is applied to a person's limb or other area for a short period of time (approximately 3 s or less) contingent upon self-injurious responses. The first research in the area is generally accepted to be that of Tate and Baroff (40). Those researchers reduced face slapping and head banging in a nine-year-old autistic male to a near zero level almost immediately consequent to using contingent shock. The reduction in self-injury was maintained for a six month period. The treatment procedure was confounded with another treatment strategy (response cost) which was also effective in reducing self-injury. However, despite this methodological error, Tate and Baroff's (40) results are typical of those of others who have since used shock therapy for self-injury. In particular Lovass and his associates (19, 20, 41, 42) have found similar near zero suppression of self-injury with the use of contingent shock therapy. For example, Lovass and Simmons (19) immediately reduced self-injury in their three subjects in a fashion similar to Tate and Baroff. They also reported that the suppressive effects of the shock failed to generalize across settings and therapists. In order to

circumvent this problem, they simply administered shock in other settings and used additional therapists. These procedures resulted in a generalized suppression of self-injury. The problem of generalization across environments and therapists does limit the applicability of such therapy. The use of such intrusive measures as shock may well be acceptable in a controlled therapeutic environment with well-trained therapists, but may not be so well accepted in schools, homes, or other more natural environments where the direct care personnel are not trained in such procedures. These latter points are supported by research performed by Merbaum (43) who, in order to achieve generalized effects, had teachers and parents apply contingent shock at home and school. It is highly unlikely that such procedures would receive acceptance on a wide scale. In addition, Tate and Baroff (40) in their study observed treatment staff using the buzz of the shock apparatus as a coercisive measure to prompt a child to drink. These observations, although isolated, do point out potentially serious misapplications of punishment in a treatment setting. In addition, Romanczyk and Goren (44) and Jones et al. (45) have reported research demonstrating that contingent shock was not effective in reducing self-injurious behaviour in their clients. In view of the above it would appear that the use of contingent aversive shock as a treatment for self-injurious behaviour requires further research to determine its effectiveness. Due to the ethical and applicability concerns at present, the future of such therapy remains uncertain (46).

Aversive techniques less intrusive than contingent shock have also received attention from behavioural researchers. For example, self-injury has been suppressed by applying aromatic ammonia to a severe head slapping 20-year-old autistic woman (47), squirting citric acid (lemon juice) into the mouth of a 19-year-old profoundly retarded male head banger (48), as well as by aversive tickling (49) and water mist spray (50). In general, all of these procedures have resulted in suppression of self-injury and although they are more acceptable forms of punishment, they are still difficult to apply and in some cases have negative side effects such as mucous membrane damage (ammonia) and chapped skin (water mist).

Another form of punishment, the removal of positive reinforcement (time-out) has also been demonstrated to reduce self-injurious behaviours. Basically, time-out involves removing the subject from the area where self-injury occurs to another area devoid of any positive reinforcements for a period of time (barren room) (51), removing reinforcement from the area where the subject is self-abusing (direct care staff leave the area) (40)), or prevention of the self-injurious response through restraint (52) or by a protective device (53). Time-out has less immediate effects on self-injury than more aversive procedures such as contingent shock, thereby decreasing

the efficiency. This is most critical when the self- injurious behaviour is resulting in severe physical damage and immediate suppressive effects are of the utmost importance.

Positive reinforcement procedures such as DRO and DRI have also been shown to be effective with self-injurious behaviour problems. The limiting factors in using purely positive approaches are the length of time required to reduce the behaviour and the intensity of the therapy in terms of staff time and training. DRO and DRI tehniques are most useful when used in combination with other procedures such as social punishment (NO) (54) and time-out (55).

As with self-stimulation, overcorrection for self-injurious behaviour has received much recent attention in the research literature. Webster and Azrin (56), in one of the initial research studies, used overcorrection with eight subjects, two of whom were self-abusive. The overcorrection procedure used with these self-abusive individuals was termed required relaxation. Consequent to a self-injurious act the subjects were instructed to lie in bed for a 2-h period. If necessary they were physically restrained in bed by staff, with the amount of restrain being contingent on the person's physical resistance. If during the last 15 min of the 2 h the subject emitted a self-injurious act, they were required to remain in bed until no such acts occurred for at least 15 min. The results, although confounded with other non-self-injurious behaviour, indicated a 95% reduction in disruptive behaviour. Another form of overcorrection, autism reversal (57), was also successfully applied as a treatment for self-injury. This procedure requires a self-injurious person to practise behaviours incompatable with self-injury. Therefore, a person who slaps his face would be required to play "Simon Says" contingent upon face slapping. There are a wide variety of such techniques that have been employed for self-injury (57). The results of this particular research project indicated a 90% reduction on day one of therapy and a 99% reduction after three months. Research in overcorrection appears quite fruitful since it is more acceptable to direct care personnel and although some of its components may be punishing (58) they are less intrusive than other methods.

The above review of behavioural treatment strategies indicates a number of factors. First, the problem is a critical one, especially in the case of self-injurious behaviour. Self-stimulation, although it does not present immediate danger to a client, does prevent the acquisition of functional skills in people demonstrating such behaviour. Secondly, although a number of treatment strategies have been researched and applied to such behaviours, these strategies are limited in a number of ways. Ethical considerations are of extreme importance, as are the intensity and

potential misapplications of treatment such as those using punishment. Third, the research support for the different forms of therapy used to reduce self-injurious behaviour is increasing, but as yet no one form of treatment has proven to be satisfactory. Non-behavioural forms of therapy and their effects on stereotypy, although not as common in the literature, may prove fruitful in the reduction of such behaviour.

Sensory integration therapy (59, 60) has received considerable attention in the occupational therapy literature as a method of treating numerous physical and behavioural deficits in children. Basically, sensory integration therapy assumes that inadequate learning occurs because of brain dysfunction (59). As such, the therapy and underlying theory holds that disordered sensory integration is a prime causative factor for learning disorders and that enriched sensory stimulation will lead to integration resulting in more adaptive responses such as the acquisition of academic skills. Such sensory integration will increase a person's ability to organize information via improved brain mechanisms and will result in more adaptive interactions with the environment. The therapy itself involves stimulating a child's auditory, visual, kinesthetic, taste, smell, and vestibular systems through the systematic application of sound, light, touch, taste, or movement of stimuli for varying degrees of time using different methodologies.

Ayres (61), without describing the type of sensory integration therapy employed, stated that such therapy resulted in greater academic gains for children with hyperactive nystagmus. These results were superior to a control group that received only continued academic training. Ayres attributed these gains to vestibular stimulation and stated that dysfunctions in that area are responsible for poor academic achievements. In another study Ayres and Haskett (62) reported research showing considerable gains in perceptual motor skills, language skills, social emotional skills, and intellectual functioning as well as a reduction of behavioural problems in a seven-year-old autistic girl. The therapy involved tactile stimulation (brushing and rubbing the body) and vestibular stimulation (swinging, spinning, rocking, rolling, and riding a scooter board down a ramp). In another poorly defined study Ayres and Mailloux (63) reported increased language expressive and comprehensive skills in three aphasic children using sensory integration (not specified) therapy. Despite the fact the study was confounded with other therapies and lacked experimental control, Ayres states.

> "Occupational therapy employing sensory integration procedures, will facilitate language comprehension of young aphasic children who have minimum-to-severe sensory processing disorders, ..." (p. 390).

In a further study (64) vestibular stimulation was attributed to an increase in eye contact in autistic children. The procedure carried out involved linear movement or non-movement on an apparatus designed for that purpose. The procedure was confounded by singing to the children in both conditions and by varying the duration of treatment contingent upon the subjects' cooperative behaviour.

Other investigators have reported positive results using Ayres' (59) sensory integration therapy. Van-Benschoten (65) reported that consequent to sensory integration therapy stressing vestibular stimulation, 8 of 16 blind children showed improved integration of reflexes and the vestibular system. The study was based on pre- and post-tests with no data presented and was confounded by numerous therapeutic interventions applied to the same children.

Poorly designed experimental programs that basically cannot be interpreted are a major problem in evaluating the effectiveness of sensory integration therapy. The reader is referred to a recent review of sensory integration therapy that clearly point out its present research deficiencies (66). There are, however, some studies that have employed more acceptable research designs in their analysis of sensory integration therapy (i.e., MacLean and Baumeister (67)) Of specific importance to the present research is vestibular stimulation and its effects on developmentally delayed children demonstrating stereotypical behaviour such as self-injury and self-stimulation.

Storey et al. (68) treated a profoundly retarded, microcephalic 12-year-old female with sensory awareness training (tactile, gustatory, and olfactory stimulation) for multiple (29) self-stimulations and non-compliance. The sensory awareness training occurred from once to three times per day and lasted 15 min per session. Data were collected three to five times per week using 10 min time samplers with 15 s interval recordings of occurrence on non-occurrence of three classes of self-stimulation (head and body, mouth, and/or hand). Measurements were recorded during sensory awareness training as well as during regular classroom time when treatment was not being applied. Results indicated a drop in the frequency of self-stimulation during treatment (mean equal to 61.4%) when compared to baseline (mean equal to 86.9%). The frequency during non-treatment regular classroom time (mean equal to 87.5%) indicated no generalized effects of the treatment gains. Storey et al. (68) stated that their research design was an alternating treatment design, when in fact it was a simple A-B design with no alternation of treatments. In spite of this error, their recording methodology does lend mild support for a positive effect of sensory awareness training on self-stimulation. The authors offer a number of possible theoretical explanations for their results.

Bonadonna (69) utilized vestibular stimulation with three severely retarded persons (two females and one male) ranging in age from 13 to 22 years. The subjects' main stereotypical behaviour was body rocking. The therapy was administered daily for 20 min during which the subjects were rocked in a linear fashion in each of four directions (1 min each) prone, supine, sitting, and in a four-point free standing position. Frequency and duration data of body rocking were obtained by using 30 s time intervals during which occurrence or non-occurrence or duration were recorded on alternate intervals. All recordings occurred directly after vestibular stimulation as well as at 1, 2, and 3 h after. Consequent to termination of the therapy the subjects were baselined six days later. The experimental paradigm was a multiple baseline across subjects design. Bonadonna (69) reported a statistically significant change from baseline to intervention and from baseline to 1 h after intervention. No differences were reported for 2 and 3 h after stimulation or at the repeat baseline six days later. The data were collapsed for all three subjects and the author reported the results as indicating that body rocking was reduced due to vestibular stimulation. However, such an analysis is inappropriate using a multiple baseline design, since the purpose of the design is to indicate similar experimental effects across subjects in an equivalent fashion over time. Perusal of Bonadonna's (69) graph indicates self-stimulation was reduced in only one subject. By collapsing the data, the degree of change produced in the aforementioned subject was strong enough to yield a significant difference for the group analysis. Therefore, the reader of this piece of research is misled to believe that vestibular stimulation reduced rocking in all three subjects, when such an effect was found in only one subject.

MacLean and Baumeister (70) studied the effects of vestibular stimulation on motor and reflex development as well as on self-stimulation using four developmentally delayed children (age range 3.8 years to 17 months). Observational data were obtained one week prior to vestibular stimulation, during two weeks of stimulation, and for one week during follow-up conducted four weeks after the cessation of vestibular stimulation. Vestibular stimulation was administered by a stationary motorized chair capable of rotating on a platform from 0.5 to 30 rpm. Each session involved 10 separate rotation periods administered in three body positions (child tilted forward, child on right or left side). The subjects received 10 sessions of stimulation over a two-week period.

The results of the experiment indicated an increase in gross motor abilities and enhanced reflex behaviour in all four subjects. The results

for self-stimulation did not yield correlated positive changes when compared to the results for motor and reflex enhancement. There was some evidence that stereotypical body rocking in two subjects was decreasing, but the data were not sufficient for McLean and Baumeister (70) to make an appropriate interpretation of the results. The effects of vestibular stimulation on the body rocking of the other two subjects indicated no change during the experiment. These mixed results would appear to warrant a further investigation of vestibular stimulation and its effects on self-stimulation.

Without making reference to sensory integration therapy or specifically vestibular stimulation, Tarnowoski et al. (71) have presented impressive data indicating decreases in self-stimulation during physical therapy with a five-year-old cerebral palsied, profoundly retarded male. They based their investigation on previous findings indicating reductions of stereotypy due to physical exercise in autistic children (72) and blind children. Tarnowski et al. (71) employed a repeated reversal single subject design with observational data collected on nine separate self-stimulating behaviours (head weaving, finger snapping, object tapping, body rocking, lip smacking, object waving, hand waving, eye blinking, inappropriate vocalizations) immediately following treatment sessions in the child's regular classroom. The recording technique employed was an interval time sampling procedure with non-occurrence or occurrence of self-stimulating being sampled every 15 s for 15 min periods. Interobserver realiability measures were obtained for 25% of all sessions. Physical therapy consisted of walker-assisted ambulation training, during which shaping, graduated guidance, and reinforcement procedures were employed. Reporting high levels of interobserver reliability (92.9%) across self-stimulatory behaviour, Tarnowski et al. (71) found repeated and definite increases in self-stimulation when ambulation training was not conducted. Specifically, reductions were found in head weaving, body rocking, hand waving, finger snapping, and inappropriate vocalizations. The other four types of self-stimulation were not affected by ambulation training. The authors report that their procedure resulted in a reduction of more "autistic" forms of self-stimulation and failed to reduce less bizarre behaviours. Tarnowski et al. (71) suggest, as do Zantall and Zantall (73) that self-stimulation may be compensatory behaviour which restores sensory homeostasis in arousal disordered children. The results of this well-controlled, appropriately interpreted study are important is the development of alternative therapeutic interventions for the reduction of stereotypical behaviour in developmentally delayed children.

Considering all of the above clinical and theoretical approaches to stereotypical behaviour, some general statements can be put forth.

Overall, behaviour therapy approaches to reducing stereotypical behaviour have been wide and varied with numerous successful applications reported in the research literature. The most efficacious behavioural treatment strategies typically involve the utilization of aversive stimuli applied to subjects demonstrating stereotypical behaviour patterns. Such punishment techniques usually require well-trained caretakers, who consistently, and in some cases for extended periods of time, carry out the treatment in well- controlled environments. In addition, due to the severity and intensity of using contingent aversive stimulation, well-qualified professional personnel must oversee such treatment procedures on a frequent basis. Finally, there are numerous ethical considerations that limit the use of physical punishment as a treatment modality. These factors, although they limit the degree to which punishment can be used, do not necessarily negate continued research and application of such treatment in the future. However, in hand with such research, efforts using less restrictive treatment approaches must also be continued.

Sensory integration therapy has received widespread attention in the physical and occupational therapy literature. It is safe to assume that, clinically, this therapeutic approach is very popular with those treating the developmentally delayed population. Unfortunately, an extensive analysis of that research literature has revealed major deficiencies in research designs employed, inadequate analyses of data, and inappropriate interpretations of the effectiveness of sensory integration therapy. Generally, there does not appear to be anecdotal support for the effectiveness of such techniques as vestibular stimulation on the motor development of the developmentally delayed. The extent to which such stimulation effects psychological states such as stereotypy is as yet quite unclear and warrants further investigation. Well-controlled experimental analyses demonstrating that vestibular stimulation reduces self-stimulation and/or self-injury would be a very positive contribution to the research and clinical literature.

The present study involves a systematic analyses of the effects of contingent and non-contingent movement upon self-stimulation and self-abuse in two severely developmentally delayed children. Of particular interest is whether or not movement, generated by an electronic bumper car, contingent upon the absence of stereotypy has differential effects when compared to movement that is not contingent upon such behaviours. The research design to be utilized is an extended single subject reversal design (74). The phases of the design can be represented as follows: A-B-A-B-A-C-A, where A = baseline, B = non-contingent movement, and C = contingent movement. This design allows a researcher to assess the effects of two independent variables upon the behaviour of a single subject. None of the

literature reviewed using sensory integration (vestibular stimulation) procedures have applied stimulation contingent upon the absence of maladaptive behavioural patterns. Of particular interest in the present research is whether or not movement functions as a reinforcement and, if so, whether or not treatment gains are superior when movement is applied contingent upon absence of stereotypy. Probes for generalization will also be conducted.

METHOD

Subjects

Subjects are expected to be selected by appropriate members of the team, who will establish their own criteria.

Setting

The following research program will be conducted at John Butler School, a day program for multiply handicapped, developmentally delayed children. The program is operated by the Ottawa and District Association for the Mentally Retarded in Ottawa, Ontario. The program has a staff-student ratio of 4:1 with appropriate support staff, teacher aides, and consultants in speech therapy, occupational therapy, physiotherapy, and behaviour management. The teachers are all well trained in dealing with the developmentally delayed and have experience in individual and group programming. All training sessions will be conducted in an area 9 m x 9 m within the school devoid of any distractions.

Trainers

Consequent to consultation with the program supervisor, two trainers for the research project were selected. Wherever possible the trainers were matched for experience, training, age, and overall ability as teachers. On the basis of these criteria, two female teachers were chosen. All sessions will be conducted by these teachers, with each being responsible for one child.

Apparatus

The "bumper car" is a three-wheeled vehicle, with the single front wheel incorporating the power source. The vehicle was designed for small children, and accordingly incorporates a safety car seat of commercial manufacture, which provides good support and security.

Across the front of the vehicle is a bumper which incorporates strip switches. These are elongated switches which close upon slight pressure. Thus, when the vehicle contacts an object in its environment, a switch is closed and a steering motor is activated. This turns the front wheel 90° so the vehicle proceeds in a new direction. This action provides random changes of direction and distance. The rider does not control the steering or the speed, but may have access to the on-off control.

In another mode of operation, the teacher or therapist controls the direction of the vehicle from a remote handset. Thus, a predetermined path can be followed and repeated for each experiment. This is the mode used in the protocols given in this paper.

Experimental Design

The design to be used involves seven phases designated as follows: A-B-A-B-A-C-A where A = baseline, B = non-contingent movement, and C = contingent movement. The following is a description of the procedures used for each phase.

Baseline

This phase will involve placing each child in the bumper car seat 15 min in the afternoon every day. Each session will be conducted at approximately the same time every day and will take place in the training area. Observational data will be obtained using a 15 s time interval procedure during which occurrence or non-occurrence of self-stimulation will be recorded for both subjects. Continuous frequency counts of self-abuse will be recorded for subject A. The observer will be cued to record by a beep on a cassette recorder programmed at 15 s intervals. A second trained observer will be present for interobserver reliability purposes on 60% of the sessions. This procedure will be constant for all four baseline phases. Transition from baseline to treatment phases will be dependent upon the stability of the obtained data (74).

Treatment Phase B

During this phase sessions will be conducted two times per day. The bumper car will be remotely operated by the trainer and will be directed along a standardized course with an equal number of left and right turns in all four directions. This will ensure equal amounts of stimulation for each subject across all sessions. Observational data will be collected in the same manner as described for baseline sessions, with 60% of the session involving interrater reliability.

Treatment Phase C

All aspects of this treatment phase will be identical to Treatment Phase B except the trainer will only activate the bumper car contingent upon a 10 s absence of self-stimulation and/or self-abuse. Demonstration of either self-stimulation or self-abuse will result in stopping the bumper car and waiting for a 10 s absence of the behaviour. An additional set of data will be collected during this phase. The number of seconds the bumper car is activated will be recorded with a stop watch. As in Phase B a second observer will be present for 60% of the sessions and will collect data identical to the primary trainer (occurrence, non-occurrence, frequency of self-abuse, and number of seconds).

Probes

Immediately following the 15 min afternoon sessions of phase B and C the following probes for generalization will occur. Subject B will be seated at a table and will be given access to toys. Recordings identical to baseline will be performed for 15 min. Subject A will be allowed to sit in an orthopaedic chair with access to toys and will also be observed in a manner identical to baseline.

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